CAT-SIUH-2000(3)
SUPERSEDES CAT-SIUH-98(2)

SARAVEL INDUSTRIAL UNIT HEATERS

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INTRODUCTION

SARAVEL industrial unit heaters can be selected from among 8 different size to match specific hydronic requirements of a variety of industrial applications such as factories, warehouses, garages, hangers, and shipping rooms. Capacities range as standard rating is from 117 to 3043 MBH for hot
water units; 147 to 4036 MBH for steam units.

Units are designed for optimum throw and distribution of heated air. Each unit is equipped with universal type cowls which individually rotate to permit altering the direction of air flow with respect to the installation position of the unit. The following design features are incorporated into the construction of *SARAVEL* unit heaters:

UNIT CASINGS
All casings are constructed of heavy gage galvanized steel sheets finished with air dried enamel.

COILS
Coils are constructed of galvanized steel sheet casings with a choice of seamless steel or copper tubes. For hot water applications with temperatures exceeding 130°C and high pressure steam applications greater than 30 psig, 1/2" seamless steel tubes are available with spiral fins made of aluminum or copper. For hot water and steam applications with normal working temperatures and pressures, 5/8" copper tubes with a choice of aluminum or copper fins in plate form are available. Fin spacing is 8FPI. Steam coils have 1 or 2 tubes rows, and hot water coils have 2 or 3 tubes rows. All coils are rated to ARI 410 Standard.

FANS
All fans are forward curved centrifugal type,designed to secure quiet and efficient operation and are made of galvanized sheet metal. Fan assembly including pulleys, sheaves, and shafts are statically and dynamically balanced.

MOTORS
Motors are 3 phase-380V-50Hz and are available at 1450 RPM or 950 RPM for applications where low noise levels are important. Spark proof motors are also available for applications where flammable and volatile gases might leak into the area.

DAMPERS (OPTIONAL)
Face and bypass dampers are of parallel blade type with damper rods that rotate in plastic bushings for smooth operation and correction resistance.

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SELECTION & APPLICATION

The logical procedure to follow for considering the several factors required for satisfactory selection and application of horizontal and vertical Industrial Unit Heaters is given below:

1. The first requirement is to calculate the total BTU per hour heat loss of the building. For complete information on heat loss calculations the ASHRAE Guide is recommended.

2. The next step is to consider these points which can have an important bearing on the quantity and type of unit heaters which should be selected to do the job most effectively: (A) Purpose of the building – factory, store, warehouse, etc. (B) Shape of building. (C) Work areas. (D) Arrangement of machinery and equipment, overhead cranes, etc.

3. In designing the system and considering the above points, select Industrial Unit Heaters with a total heating capacity approximately equal to the calculated heat loss. The number of units to use depends largely on the requirement for close temperature control. In order to provide even distribution and close temperature control in areas where this is desirable for comfort, such as stores, offices and certain factory work areas, a quantity of small capacity units should be considered. In other areas where uniform temperature is not an important factor, such as typical factory and warehouse spaces, large capacity units should be used since this result in a more economical installation.

4. The selection of horizontal or vertical units or a combination of both types will usually be dictated by the shape of the building and arrangement of the equipment.

Horizontal Units (horizontal discharge) are recommended for areas having low ceilings, such as stores, show rooms and hallways, as well as areas with comparatively high ceilings, such as factories and warehouses, provided the units can be mounted at a suitable height so the horizontal flow of air will not be stopped by machinery or other obstructions.

Vertical Units (down blast discharge) are particularly suitable for buildings with high ceilings, and for areas that require the units to be mounted at a comparatively high position in order to clear obstacles such as cranes, and high stacks and rows of materials.

5. After selecting the proper quantity and type of units to provide the required heat, certain general rules can than be followed to accomplish the most effective application. (A) Horizontal units should be positioned to blow along the outside walls to obtain a wiping action over the exposed surfaces. Most effective coverage will result if the units can be arranged so the air from one unit blows toward the air intake on another unit, thereby setting up a gentle circulation within the building.This arrange-ment promotes even distribution and uniform temperature. If additional units are required to handle the heat loss, they can be arranged to blow toward the interior of the building. (B) Vertical units should be located at sufficient height so that the warm air that tends to accumulate near the ceiling will be reirculated to the working level. When only vertical units are used, they should be arranged to provide a blanketing effect over the exposed surfaces and doorways.

SELECTION EXAMPLES

STEAM APPLICATION
An application calls for the selection of an Industrial Unit Heater given the following design conditions:

Entering Air Temperature, (EAT) ….....30°F*
Steam Pressure available .....….....15 psig
Heating Load .....700,000 BTU/Hr

Standard ratings for *SARAVEL* Industrial Unit Heaters are based on 30 psig steam pressure and 60°F entering air temperature. Since the given conditions are not based on the standard conditions, a correc- tion factor should be applied to the heating load. From TABLE 3 the correction factor for 30°F entering air temperature and 15 psig steam pressure is 1.026. Applying the correction factor:

700,000 x 1.026 = 718,200 BTU/Hr

From TABLE 1 a two row steam industrial unit heater, Model 2B14S with the following ratings can be selected:

BTUH = 752,000
CFM = 7300

The rating of the selected unit should now be corrected to the job design condition by applying the correction factor:

$$\frac{752{,}000}{1.026} = 732{,}900 \text{ BTUH}$$

Since the standard ratings are based on 60°F entering air temperature, in order to obtain the CFM delivery in this case for 30°F entering air, a CFM correction factor should be applied. Enter TABLE 5 at 30°F entering air temperature to read the CFM correction factor:

CFM correction factor from TABLE 5 = 1.060
CFM @ 60°F = 7300 x 1.060 = 7738

The final air temperature, $T_{final,}$ can be obtained using the following equation:

Calculate the final air temperature
The final air temperature can be determined according to the following formula:

$$T_{final} = \frac{\text{Converted BTU rating}}{\text{CFM @ 60° F x 1.087}} + T_{inlet}$$

$$= \frac{732{,}900}{7738 \text{ x } 1.087} + 30°F = 117°F$$

*Note: This is a full fresh air application.

Calculate the amount of condensate formed
In order to size steam traps, the amount of condensate formed per unit should be determined. Multiply the rated capacity of the unit by the steam correction factor found previously and divide by the latent heat of steam (BTU/lb) at the given pressure from TABLE 9.

Condensate (lb/hr) = (752,000 x 1.026) / 945.5
= 816 lb/hr

HOT WATER APPLICATION
An Industrial Unit Heater is to be selected given the following design conditions:

Entering Air Temperature, (EAT) .....60°F
Entering Water Temp.,(EWT) .....210°F
Leaving Water Temp., (LWT) .....160°F
Heating Load .....600 MBH

Since the ratings for hot water applications are based on 180°F EWT and this application calls for 210°F EWT, the correction from TABLE 4 at 60°F EAT and 210°F EWT is 1.270. Applying the correction factor to the load:

$$\frac{600{,}000}{1.270} = 472{,}000 \text{ BTU/Hr}$$

From TABLE 2 a 3 row Model 2B14 with the following ratings can be selected:

BTUH = 502,900
CFM = 6700
GPM = 51.7

The rating of the selected unit should now be corrected to the job design condition by applying the correction factor:

502,900 x 1.270 = 638,000 BTU/Hr

Calculate the final air temperature
The final air temperature can be obtained by the following equation:

$$T_{final} = \frac{\text{Converted BTU rating}}{\text{CFM @ 60° F x 1.087}} + T_{inlet}$$

$$= \frac{638{,}000}{6700 \text{ x } 1.087} + 60°F = 148°F$$

SELECTION EXAMPLES

Calculate CFM @ the final temperature
The following formula can be used to determine the CFM at the final air temperature:

$$\text{CFM @ Final Temp.} = \text{Rated CFM} \times \frac{460 + T_{final}}{460 + 70}$$

$$= 6700 \times \frac{460+148}{460+70} = 7686$$

Determine GPM

$$GPM = \frac{BTU/Hr}{500\ \Delta T}$$

$$= \frac{638{,}000}{500 \times 50} = 25.5$$

where ΔT is the water temperature drop (210 – 160 = 50°F) through the unit.

Calculate pressure drop in the coil

$$\%\ \text{Water Quantity} = \frac{GPM}{\text{Rated GPM} \leftarrow \text{From TABLE 2}}$$

$$= \frac{25.5}{51.7} = 49\%$$

Enter TABLE 6 and interpolate between 40 and 50 percent Water Quantity to obtain the pressure drop multiplier as 0.28. Next apply the multiplier to the rated pressure drop for Model 2B14 in TABLE 2 under the P.D. column:

P.D. = 1.842 x 0.28 = 0.52 Feet Water

RPM and HP CORRECTION FACTORS
If ductwork is to be installed to supply heated air to a location other than where the unit is installed, it is than necessary to adjust motor RPM and HP. Suppose the given external static pressure for model 2B14 in the previous example is:

Ext. Sp = 3/4" w.g.

From TABLE 2, at 6700 CFM the cowl outlet velocity is 2820 FPM. Entering TABLE 7 at 3/4" w.g. and interpolating between 2800 and 3000 FPM, the RPM correction factor is calculated as 1.238. Similarily the HP correction factor is calculated as 1.495.

Applying the correction factors to RPM and HP listed in TABLE 7 :

RPM = 743 x 1.242 = 920
HP = 3 x 1.495 = 4.5 ➡ 5.5 HP

TABLE 1. STEAM INDUSTRIAL UNIT HEATER RATINGS *

MODEL	CFM	HP	RPM	1ROW			2 ROW		
				BTU/Hr	LDB°F	FPM **	BTU/Hr	LDB°F	FPM **
1B13S	2000	0.75	814	146900	128	1680	247600	174	1810
	2300	0.75	837	157600	123	1920	269000	168	2060
	2600	1	873	167800	119	2150	288900	162	2310
	2900	1	914	176800	116	2390	307400	158	2560
	3200	1.5	959	185500	113	2620	324900	153	2810
	3500	1.5	1004	193700	111	2860	341500	150	3050
2B11S	2750	1	959	203000	128	1800	341900	174	1950
	3200	1	949	219200	123	2080	374100	168	2240
	3650	1.5	956	234100	119	2360	403800	162	2530
	4100	1.5	982	247800	116	2630	431500	157	2820
	4550	2	1021	260700	113	2910	457400	152	3110
	5000	2	1069	272800	110	3180	481900	149	3400
2B13S	3750	1.5	827	282400	129	1780	473800	176	1920
	4300	1.5	821	302800	125	2030	514300	170	2180
	4850	1.5	829	321600	121	2270	551900	165	2440
	5400	2	852	339200	118	2520	587200	160	2700
	5950	2	886	355700	115	2760	620400	156	2950
	6500	3	924	371300	113	3000	651800	152	3210
2B14S	5500	2	720	374200	123	2290	639400	167	2460
	6100	2	728	394000	119	2530	679100	162	2710
	6700	3	743	412700	117	2760	716500	158	2960
	7300	3	766	430300	114	3000	752000	155	3210
	7900	3	794	447100	112	3230	785900	152	3450
	8500	4	824	463200	110	3460	818300	149	3700
2B17S	7000	3	587	492900	125	1940	837200	170	2090
	8200	3	583	533500	120	2250	918400	163	2420
	9400	3	592	570600	116	2570	992900	157	2750
	10600	4	614	605000	113	2880	1062100	152	3080
	11800	5.5	643	637000	110	3190	1126800	148	3400
	13000	5.5	675	667100	107	3500	1187700	144	3720
2B19S	10000	4	523	719600	126	2060	1217500	172	2220
	12000	4	536	788600	121	2440	1355300	164	2630
	14000	5.5	557	850900	116	2830	1480300	157	3030
	16000	7.5	587	907900	112	3210	1595300	152	3430
	18000	10	623	960800	109	3590	1702000	147	3830
	20000	10	693	1010200	107	3970	1801900	143	4230
3B19S	15000	5.5	523	1045700	124	2050	1779300	169	2210
	17600	5.5	530	1132500	119	2380	1953100	162	2560
	20200	7.5	548	1211900	115	2720	2112500	156	2910
	22800	10	571	1285200	112	3050	2260300	151	3260
	25400	10	597	1353600	109	3380	2398400	147	3600
	28000	15	625	1417900	107	3710	2528300	143	3950
4B19S	24000	7.5	532	1733400	126	2470	2930800	172	2660
	27600	10	552	1859800	122	2820	3183000	166	3030
	31200	15	577	1976500	118	3160	3417000	161	3400
	34800	15	604	2085300	115	3510	3635600	156	3760
	38400	20	634	2187400	112	3850	3841400	152	4120
	42000	25	700	2283900	110	4200	4036000	148	4480

* Ratings are based on 30 Psig Steam, 60°F Entering Air Temp. and 5/8" copper tubes with plate fins as standard.

** FPM is discharge air velocity (ft/min), at Final Air Temp. equivalent to cowl outlet velocity.

Note: a) Fan ratings are based on standard air (Density=0.075 lb/ft³ at sea level, 70°F, and 29.92 inches of mercury barometric pressure) with total static pressure of 1" w.g.

b) All coils are rated to ARI 410 Standard.

c) Fin spacing is 8FPI.

RATINGS

TABLE 2. HOT WATER INDUSTRIAL UNIT HEATER RATINGS*

MODEL	CFM	HP	RPM	2 ROWS					3 ROWS				
				BTU/Hr	GPM	PD (ft)	LDB °F	FPM**	BTU/Hr	GPM	PD (ft)	LDB °F	FPM**
1B13	2000	0.75	814	117100	12.0	0.096	114	1640	158900	16.3	0.249	133	1700
	2300	0.75	837	127800	13.1	0.112	111	1880	175100	18.0	0.296	130	1940
	2600	1	873	137700	14.2	0.128	109	2110	190400	19.6	0.345	127	2180
	2900	1	914	147100	15.1	0.144	107	2350	204800	21.0	0.394	125	2420
	3200	1.5	959	156000	16.0	0.160	105	2580	218600	22.5	0.443	123	2670
	3500	1.5	1004	164400	16.9	0.176	103	2820	231800	23.8	0.492	121	2910
2B11	2750	1	959	168000	17.3	0.188	116	1770	224700	23.1	0.477	135	1830
	3200	1	949	184900	19.0	0.224	113	2050	249900	25.7	0.578	132	2110
	3650	1.5	956	200500	20.6	0.259	111	2320	273500	28.1	0.681	129	2400
	4100	1.5	982	215200	22.1	0.294	108	2600	295900	30.4	0.785	126	2680
	4550	2	1021	229100	23.5	0.330	106	2880	317000	32.6	0.889	124	2970
	5000	2	1069	242300	24.9	0.365	105	3150	337300	34.7	0.994	122	3250
2B13	3750	1.5	827	237300	24.4	0.281	118	1750	314100	32.3	0.699	137	1810
	4300	1.5	821	259000	26.6	0.329	115	2000	346100	35.6	0.833	134	2060
	4850	1.5	829	279300	28.7	0.377	113	2240	376400	38.7	0.969	131	2310
	5400	2	852	298400	30.7	0.425	111	2490	105100	41.6	1.107	129	2560
	5950	2	886	316600	32.5	0.473	109	2730	432500	44.4	1.246	127	2820
	6500	3	924	333900	34.3	0.521	107	2970	458800	47.1	1.386	125	3070
2B14	5500	2	720	329000	33.8	0.571	115	2260	439000	45.1	1.441	133	2330
	6100	2	728	351100	36.1	0.641	113	2500	471700	48.5	1.641	131	2580
	6700	3	743	372000	38.2	0.712	111	2730	502900	51.7	1.842	129	2820
	7300	3	766	392000	40.3	0.783	109	2970	532900	54.7	2.045	127	3060
	7900	3	794	411100	42.2	0.853	108	3210	561700	57.7	2.249	125	3310
	8500	4	824	429500	44.1	0.923	107	3440	589400	60.6	2.454	124	3550
2B17	7000	3	587	437500	45.0	0.913	118	1920	577300	59.3	2.259	136	1980
	8200	3	583	483500	49.7	1.093	114	2230	644900	66.3	2.759	132	2300
	9400	3	592	526200	54.1	1.274	112	2550	708200	72.8	3.268	129	2630
	10600	4	614	566200	58.2	1.454	109	2860	767800	78.9	3.782	127	2950
	11800	5.5	643	603900	62.0	1.634	107	3170	824300	84.7	4.299	124	3270
	13000	5.5	675	639500	65.7	1.812	105	3480	878000	90.2	4.819	122	3590
2B19	10000	4	523	640000	65.8	1.136	119	2030	839600	86.3	2.784	137	2090
	12000	4	536	718700	73.8	1.401	115	2420	954600	98.1	3.511	133	2500
	14000	5.5	557	791000	81.3	1.666	112	2810	1061400	109.0	4.252	130	2900
	16000	7.5	587	858200	88.2	1.931	109	3190	1161300	119.3	5.002	127	3290
	18000	10	623	921100	94.6	2.194	107	3580	1255300	129.0	5.758	124	3690
	20000	10	693	980300	100.7	2.455	105	3960	1344400	138.1	6.517	122	4080
3B19	15000	5.5	523	959400	98.6	3.081	119	2030	1254500	128.9	7.503	137	2090
	17600	5.5	530	1062000	109.1	3.702	116	2370	1403600	144.2	9.191	133	2440
	20200	7.5	548	1157200	118.9	4.323	113	2700	1543100	158.5	10.907	130	2790
	22800	10	571	1246300	128.0	4.943	110	3040	1674500	172.0	12.643	128	3130
	25400	10	597	1330200	136.7	5.561	108	3370	1798900	184.8	14.391	125	3480
	28000	15	625	1409700	144.8	6.175	106	3710	1917200	197.0	16.147	123	3820
4B19	24000	7.5	532	1594800	163.8	5.660	121	2450	2066000	212.3	13.554	139	2520
	27600	10	552	1745200	179.3	6.661	118	2800	2282400	234.5	16.228	136	2880
	31200	15	577	1886200	193.8	7.665	116	3150	2486800	255.5	18.948	133	3250
	34800	15	604	2019200	207.4	8.670	113	3500	2680800	275.4	21.702	131	3610
	38400	20	634	2145300	220.4	9.673	111	3850	2865700	294.4	24.483	129	3960
	42000	25	700	2265400	232.7	10.673	110	4190	3042600	312.6	27.281	127	4320

* Ratings are based on 180°F entering water temp. & 1 60°F leaving water temp.& 60°F entering air temp. and 5/8" copper tubes with plate fins as standard.
** FPM is discharge air velocity (ft/min), at Final Air Temp. equivalent to cowl outlet velocity.
Note: a) Fan ratings are based on standard air (Density=0.075 lb/ft³ at sea level, 70°F, and 29.92 inches of mercury barometric pressure) with total static pressure of 1" w.g.
b) All coils are rated to ARI 410 Standard.
c) Fin spacing is 8FPI.
d) Shaded areas are conditions where water velocities exceed 6 fps.

TABLE 3. STEAM CORRECTION FACTORS*

ENT. AIR TEMP °F	STEAM PRESSURE IN POUNDS PER SQUARE INCH - PSIG															
	0	2	5	10	15	20	30	40	50	60	80	100	125	150	175	200
-30	1.133	1.163	1.200	1.258	1.308	1.348	1.420	1.482	1.532	1.585	1.654	1.717	1.792	1.847	1.903	1.956
-20	1.082	1.113	1.153	1.211	1.258	1.301	1.373	1.431	1.483	1.528	1.605	1.670	1.740	1.801	1.855	1.903
-10	1.036	1.066	1.107	1.164	1.212	1.254	1.325	1.384	1.436	1.481	1.558	1.623	1.693	1.755	1.808	1.856
0	0.989	1.020	1.060	1.117	1.166	1.207	1.278	1.338	1.389	1.434	1.512	1.576	1.647	1.708	1.762	1.810
10	0.942	0.973	1.013	1.071	1.118	1.161	1.233	1.292	1.342	1.388	1.465	1.530	1.601	1.660	1.715	1.764
20	0.896	0.926	0.967	1.024	1.073	1.114	1.186	1.244	1.296	1.341	1.418	1.483	1.553	1.615	1.669	1.717
30	0.849	0.880	0.920	0.977	1.026	1.067	1.139	1.198	1.250	1.294	1.372	1.436	1.506	1.568	1.622	1.670
40	0.802	0.833	0.873	0.930	0.978	1.021	1.092	1.151	1.202	1.248	1.325	1.390	1.461	1.521	1.575	1.628
45	0.779	0.810	0.850	0.907	0.955	0.997	1.069	1.128	1.180	1.224	1.302	1.366	1.436	1.496	1.552	1.601
50	0.756	0.786	0.827	0.884	0.932	0.974	1.045	1.104	1.156	1.201	1.273	1.343	1.414	1.474	1.529	1.576
55	0.732	0.763	0.803	0.861	0.908	0.951	1.023	1.081	1.133	1.178	1.255	1.320	1.390	1.451	1.505	1.553
60	0.709	0.740	0.780	0.837	0.885	0.927	**1.000**	1.058	1.109	1.154	1.231	1.297	1.367	1.427	1.482	1.531
65	0.686	0.716	0.757	0.814	0.862	0.904	0.976	1.034	1.086	1.131	1.209	1.273	1.343	1.407	1.459	1.506
70	0.662	0.693	0.733	0.791	0.838	0.881	0.935	1.011	1.063	1.108	1.186	1.250	1.320	1.380	1.435	1.484
75	0.639	0.670	0.710	0.767	0.815	0.857	0.930	0.988	1.040	1.084	1.163	1.226	1.297	1.357	1.412	1.460
80	0.616	0.646	0.687	0.744	0.792	0.834	0.906	0.965	1.016	1.061	1.139	1.203	1.273	1.335	1.389	1.436
85	0.592	0.623	0.663	0.720	0.768	0.811	0.883	0.941	0.993	1.038	1.116	1.180	1.251	1.310	1.365	1.414
90	0.569	0.600	0.640	0.696	0.745	0.787	0.860	0.918	0.969	1.014	1.093	1.156	1.226	1.288	1.342	1.390
100	0.522	0.553	0.593	0.650	0.698	0.732	0.813	0.871	0.923	0.968	1.045	1.110	1.181	1.240	1.295	1.344
110	0.476	0.506	0.547	0.603	0.652	0.694	0.766	0.825	0.876	0.921	0.998	1.063	1.134	1.194	1.248	1.297
120	0.429	0.460	0.500	0.556	0.605	0.647	0.720	0.778	0.830	0.874	0.952	1.027	1.086	1.147	1.201	1.251
140	0.336	0.366	0.407	0.464	0.512	0.554	0.626	0.685	0.737	0.781	0.858	0.923	0.993	1.055	1.108	1.156
160	0.242	0.273	0.313	0.370	0.418	0.460	0.533	0.591	0.642	0.688	0.765	0.831	0.901	0.961	1.012	1.065
180	0.149	0.179	0.220	0.277	0.325	0.367	0.439	0.498	0.550	0.594	0.671	0.737	0.808	0.868	0.921	0.970
200	0.056	0.085	0.127	0.183	0.232	0.274	0.345	0.405	0.455	0.501	0.577	0.643	0.713	0.775	0.829	0.876

*Standard ratings are based on 30 psig steam pressure @ 60°F Entering Air Temperature and 5/8" copper tubes with plate fins.
For steam pressure greater than 30 psig, 1/2" seamless steel tubes with spiral fins are avalable.
Corrected Load = Rating from TABLE 1 x Correction factor from TABLE 3

TABLE 4. HOT WATER CORRECTION FACTORS

ENTERING AIR TEMPERATURE °F	ENTERING WATER TEMPERATURE °F										
	150	160	170	180	190	200	210	220	230	240	250
30	0.980	1.070	1.160	1.250	1.340	1.430	1.525	1.615	1.710	1.800	1.895
40	0.900	0.985	1.075	1.165	1.255	1.350	1.440	1.530	1.625	1.715	1.810
50	0.815	0.905	0.995	1.085	1.175	1.265	1.355	1.445	1.540	1.630	1.720
60	0.735	0.825	0.910	**1.000**	1.090	1.180	1.270	1.360	1.455	1.545	1.635
70	0.655	0.740	0.830	0.915	1.005	1.095	1.185	1.275	1.365	1.460	1.550
80	0.570	0.660	0.745	0.840	0.920	1.010	1.100	1.190	1.280	1.370	1.465
90	0.490	0.575	0.660	0.750	0.840	0.925	1.015	1.105	1.195	1.285	1.380
100	0.410	0.495	0.580	0.665	0.755	0.840	0.930	1.020	1.110	1.200	1.290

TABLE 5. CFM CORRECTION FACTORS

ENTERING WATER TEMPERATURE °F											
-10	0	10	20	30	40	50	60	70	80	90	100
1.155	1.130	1.105	1.082	1.060	1.040	1.020	**1.000**	0.982	0.964	0.945	0.930

CORRECTION FACTORS

TABLE 6. COIL PRESSURE DROP CORRECTION FACTORS *

PERCENT WATER QUANTITY G.P.M.														
40	50	60	70	80	90	100	110	120	130	140	150	160	170	180
0.19	0.29	0.40	0.53	0.67	0.83	1.00	1.18	1.38	1.59	1.81	2.05	2.30	2.55	2.83

* Corrected Coil Pressure Drop = P.D. from TABLE 2 x Correction factor from TABLE 6

TABLE 7. RPM CORRECTION FACTORS

COWEL OUTLET VEL. (FPM)	EXTERNAL STATIC PRESSURE (Inches Water Gage)				
	1/4	1/2	3/4	1	1 1/4
1800	1.16	1.31	1.45		
2000	1.15	1.30	1.44		
2200	1.14	1.28	1.42	1.53	1.65
2400	1.12	1.24	1.36	1.47	1.58
2600	1.11	1.21	1.30	1.40	1.50
2800	1.07	1.15	1.24	1.33	1.42
3000	1.07	1.14	1.22	1.30	1.39
3200	1.06	1.13	1.20	1.28	1.35
3400	1.06	1.12	1.18	1.24	1.30
3600	1.05	1.10	1.15	1.19	1.24
3800	1.05	1.09	1.14	1.18	1.22

NOTE: The RPM correction (At various external static pressures) must be made by multiplying its respective ratings capacity table values by the factors in the TABLE 7.

TABLE 8. HP CORRECTION FACTORS

COWEL OUTLET VEL. (FPM)	EXTERNAL STATIC PRESSURE (Inches Water Gage)				
	1/4	1/2	3/4	1	1 1/4
1800	1.35	1.72	2.09		
2000	1.32	1.68	2.13		
2200	1.29	1.63	1.98	2.34	2.71
2400	1.24	1.52	1.82	2.14	2.46
2600	1.19	1.41	1.66	1.93	2.21
2800	1.14	1.31	1.50	1.73	1.96
3000	1.13	1.29	1.45	1.65	1.86
3200	1.13	1.26	1.41	1.59	1.77
3400	1.11	1.23	1.36	1.50	1.65
3600	1.11	1.21	1.31	1.40	1.52
3800	1.10	1.20	1.29	1.39	1.50

NOTE: The HP correction (At various external static pressures) must be made by multiplying its respective ratings capacity table values by the factors in the TABLE 8.

AIR THROW DATA

TABLE 9. PROPERTIES OF SATURATED STEAM

PRESSURE PSIG	TEMP °F	LATENT HEAT BTU/lb
0	212.00	970.40
2	218.47	966.20
3	221.50	964.27
5	227.16	960.54
8	234.78	955.58
10	239.41	952.45
15	249.73	945.49
20	258.79	939.26
25	266.85	933.63
30	274.08	928.50
35	280.64	923.77
40	286.74	919.27
45	292.37	915.14
50	297.70	911.24
60	307.30	903.91
70	316.03	897.28
75	320.00	894.20
80	323.89	891.08
90	331.16	885.42
100	337.86	880.82
110	344.22	874.85
120	350.09	870.05
125	353.00	867.70
130	355.65	865.48
140	360.89	861.12
150	365.92	856.92
175	377.47	847.02
200	387.88	838.00
225	397.27	828.30
250	406.01	820.00

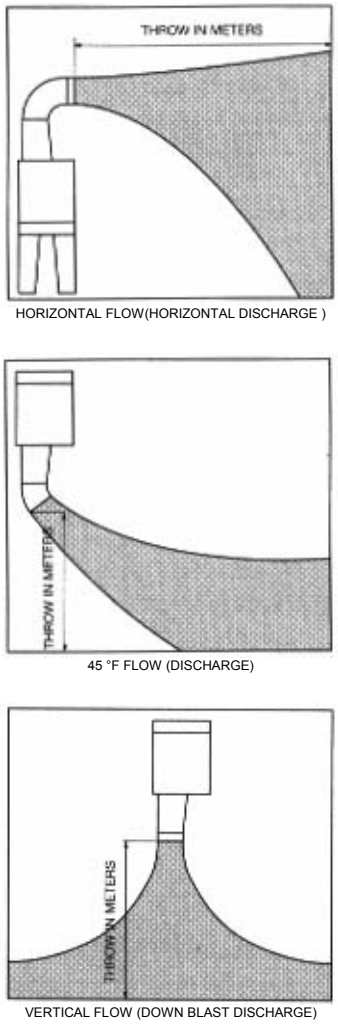


FIGURE 1. THROW OF AIR (MOUNTING HEIGHTS)

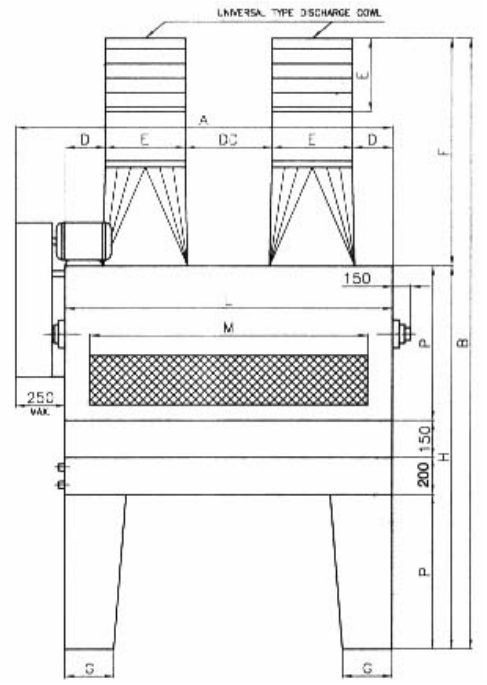
TABLE 10. THROW OF HEATED AIR IN METERS (See Figure 1)

MODEL	OUTLET VELOCITY F.P.M.														
	HORIZONTAL FLOW (DISCHARGE)					45° FLOW (DISCHARGE)					VERTICAL FLOW (DISCHARGE)				
	1800	2300	2800	3300	3800	1800	2300	2800	3300	3800	1800	2300	2800	3300	3800
1B13	18	21	24	27	31	7	9	11	14	16	9	12	15	18	22
2B11	15	18	20	24	29	6	8	9	12	13	8	11	14	17	20
2B13	18	21	24	27	31	7	9	11	14	16	9	12	15	18	22
2B14	20	23	26	30	35	8	10	12	15	17	10	13	16	19	24
2B17	23	26	30	35	40	9	11	14	16	19	12	15	18	22	26
2B19 3B19 4B19	28	32	36	40	45	9	12	16	18	21	14	17	21	25	28

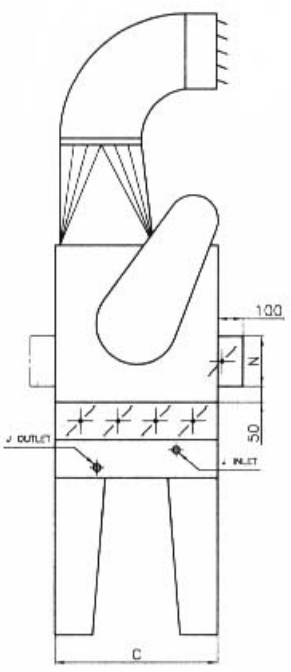
DIMENSIONS

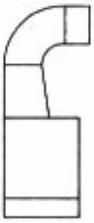
TABLE 11. INDUSTRIAL UNIT HEATER DIMENSIONS

MODEL	A	B	C	D	DD	E	F	G	H	J	K	L	M	N	P	No. of Outlets
1B13	1150	2600	600	275	-----	330	950	200	1600	1.25"	500	900	650	200	650	1
2B11	1400	2600	650	150	290	280	950	200	1600	1.5"	500	1150	1000	200	650	2
2B13	1600	2600	750	180	330	280	950	200	1600	1.5"	500	1350	1200	200	650	2
2B14	1850	2750	750	250	400	350	1000	200	1700	2.0"	550	1600	1400	200	700	2
2B17	2200	2950	850	280	530	430	1100	200	1800	2.0"	550	1950	1750	300	750	2
2B19	2400	3650	1100	300	550	500	1300	300	2300	2.5"	600	2150	1950	300	1000	2
3B19	3250	3650	1100	250	500	500	1300	300	2300	2.5"	600	3000	2800	300	1000	3
4B19	4100	3650	1450	250	450	500	1300	350	2300	2.5"	600	3850	3600	300	1000	4

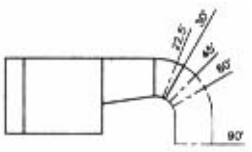


UP BLAST DISCHARGE
WITH FREE STANDING LEGS (OR SUSPENDED)

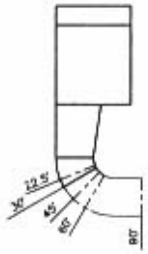




UP BLAST DISCHARGE (SUSPENDED)

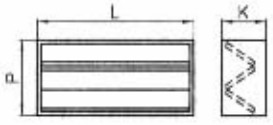


TOP HORIZINTAL DISCHARGE (SUSPENDED)



DOWN BLAST DISCHARGE (SUSPENDED)

CHOOSE DESIRED DISCHARGE
ANGLE FROM ABOVE.



FILTER BOX

THE FILTER BOX CAN BE USED ON
ALL ARRANGEMENTS (OPTIONAL)

FIGURE 2. INDUSTRIAL UNIT HEATER DIMENSIONS
Drive, face and bypass damper shaft, coil connections and filter access door may be on either end.

Piping Suggestions

As the function of a unit heater is to transfer heat from steam or hot water to the surrounding space, it is necessary that the steam or hot water be delivered to the unit and removed from it, in the required quantity and condition. The piping of the unit heaters must conform strictly to the system requirements, while at the same time permitting the heaters to function as intended. The following are a few piping guidelines which must be observed when designing piping systems for unit heaters.

Piping size should be adequate to handle both steam and condensate, under the maximum load condition. With steam unit heaters the steampiping must be size to carry a full supply of steam to the unit to take the place of that con-densed. In hot water systems, piping should be sized properly to handle required flow (GPM) of water.

When installing steam unit heaters the supply line should be pitched towards the steam main in order to prevent condensate in the main from draining through the heater, where it might reduce capacity and case noise. With hot water unit heater both supply and return branch lines should be pitched towards the unit.

The return line from steam unit heater should provide a minimum drop of 300 mm (12") below The heater, so that the heat of water required to overcome the resistances of check valves, traps, and strainers will not cause condensate to remain in the coil.

4- Rapid condensation of steam, specially during heating-up periods, is characteristic of steam unit heaters. Steam traps with ample capacity to handle the condensate when the unit is operating under maximum steam pressure and minimum entering air temperature plus a suitable safety factor should be selected.

5- Dirt pockets at the outlet of unit heaters are essential, and strainers with 1.5mm (1/16") perforations are recommended as additional means of retaining dirt and scale which might affect operation of check valves and traps.

6- The vertical connection to the air vent should be at least 3/4" pipe thread, to permit separation of the water from the air passing to the vent.

7- To ensure optimum performance of the unit heaters at the rated capacity, all supply mains and branch connections to the units should be insulated.

8- Steam piping and unit heaters should be sup-ported independently.

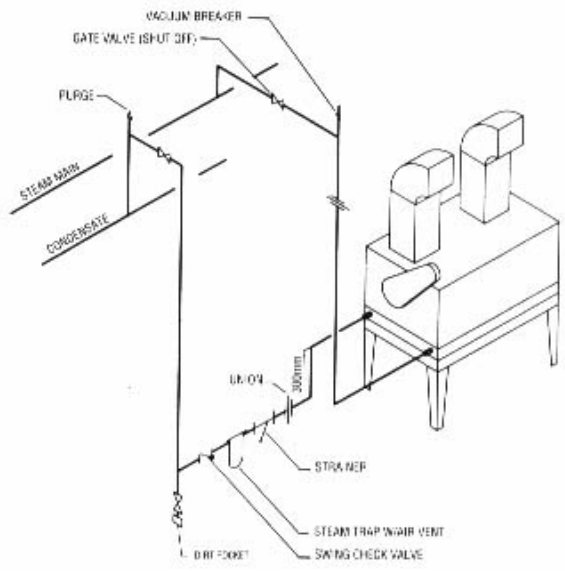


FIGURE 3. STEAM HEATING SYSTEMS

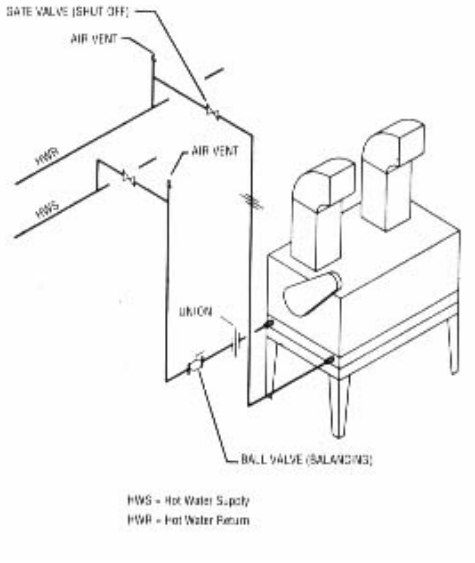


FIGURE 4. HOT WATER SYSTEMS

ENGINEERING SPECIFICATIONS

UNIT CASINGS
All casings shall be constructed of heavy gage galvanized steel sheets painted with hammer finish after final assembly.

COILS
Coils shall be constructed of galvanized steel sheet casings with copper tubes or (seamless steel tubes). For hot water applications with temperature exceeding 130°C and high pressure steam applications greater than 30 psig, 1/2" seamless steel tubes shall be utilized with spiral fins made of aluminium or copper. For hot water and steam applications under normal working temperature and pressure, 5/8" copper tubes with aluminium (copper) fins in plate from shall be used. Fin spacing shall be 8FPI. Steam coils shall be 1 or 2 tubes rows, and hot water coils shall be 2 or 3 tubes rows.

All coils shall be pressure tested with 325 psig air in an illuminated tank according to ASHRAE Standard 15-1992 (Safety Code for Mechanical Refrigeration).

FANS
All fans shall be of double inlet, forward curved centrifigual type fabricated from galvanized sheet metal. Fan assembly including pulleys, sheaves, and shafts shall be statically and dynamically balanced.

All shafts shall be oxide conversion coated.

MOTORS
All motors shall be 3 phase-380-50Hz and shall operate at 1450 RPM or 950 RPM (for applications where low noise levels are important). Motors with spark proof construction shall also be employed for applications where flammable and volatile gases might leak into the area.

DAMPERS
Standard face and bypass dampers shall be of parallel blade type with interconnecting linkage. Blade bearings shall be plastic bushings and shall provide smooth operation and corrosion resistance.

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